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Mahdi Al-Kaisi

Iowa State University, malkaisi@iastate.edu

Mark A. Licht

Iowa State University, lichtma@iastate.edu

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Effects of Long-term Tillage and Crop Rotation on Soil Carbon and Soil Productivity

Abstract

Tillage system and crop rotation significantly affect long-term soil productivity and soil quality components such as soil carbon and other soil physical, biological, and chemical properties. In addition, both tillage and crop rotation affect weed and soil disease control. There is a definite need for well-defined, long-term tillage and crop rotation studies across the different soil and climatic conditions in the state. The objective of this study is to evaluate the long-term effects of different tillage systems and crop rotations on soil productivity.

Keywords

Agronomy

Disciplines

Agricultural Science | Agriculture | Agronomy and Crop Sciences

Effects of Long-term Tillage and Crop Rotation on Soil Carbon and Soil Productivity

Mahdi Al-Kaisi, assistant professor
Mark Licht, program specialist
Department of Agronomy

Introduction

Tillage system and crop rotation significantly affect long-term soil productivity and soil quality components such as soil carbon and other soil physical, biological, and chemical properties. In addition, both tillage and crop rotation affect weed and soil disease control. There is a definite need for well-defined, long-term tillage and crop rotation studies across the different soil and climatic conditions in the state. The objective of this study is to evaluate the long-term effects of different tillage systems and crop rotations on soil productivity.

Materials and Methods

This study was originated on eight Iowa State University Research and Demonstration Farms in 2002 and continued in 2003. Treatments included five tillage systems (no-till, strip-tillage, chisel plow, deep ripper, and moldboard plow) and two crop rotations (corn-corn-soybean and corn-soybean) across the five tillage systems and several soil associations. Initial soil samples were collected in 2002 prior to implementing the tillage treatments. The soil samples were collected from all sites for depths 0–6, 6–12, 12–18, and 18–24 inches and were analyzed for total carbon and total nitrogen. The experimental design was a randomized complete block design with four replications.

The plot size is 20 rows \times 65 ft. Yield is determined from the center four rows of each plot. The long-term effects of tillage and crop rotation on total soil carbon and total nitrogen are monitored biyearly, or more frequently. Seasonal measurements such as nitrogen use efficiency, soil bulk density, infiltration rate,

etc., were conducted on selected sites depending on availability of funding.

Results and Discussion

In 2002, corn yields under a corn-soybean rotation and soybean yields under a corn-corn-soybean rotation were not significant for all tillage systems (Figures 1 and 3), with an average corn and soybean yield of 94 and 36 bushels/acre, respectively. In 2003, the five tillage systems under corn-corn-soybean rotation did not show a significant difference in corn yield, averaging 142 bushels/acre (Figure 2). However, in 2003, for the corn-soybean rotation the no-till soybean yield was significantly greater than both chisel plow and moldboard plow yields. On the other hand, no-till soybean yield was not significantly different from yields of strip-tillage or deep ripping (Figure 4).

Differences in corn yield for 2002 and 2003 can be attributed to differences in weather conditions. Precipitation was 12.25 inches less than normal in 2002, compared with 2003 where precipitation was 10.51 inches less than normal. The drier weather conditions in 2002 resulted in a corn yield of 94 bushels/acre for the corn-soybean rotation compared with 142 bushels/acre for the corn-corn-soybean rotation across all tillage systems.

It is too early to speculate about the tillage or the crop rotation effects on yield because these systems have only been in place 2 years.

Acknowledgments

We would like to thank Bernard Havlovic and Jeff Butler for their time and labor for plot setup, planting, and harvesting.

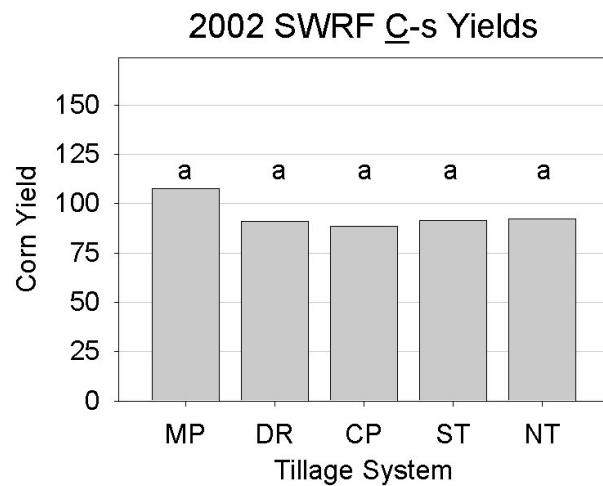


Figure 1. Effect of tillage system on corn yield in a corn-soybean rotation for 2002 at Lewis, IA.

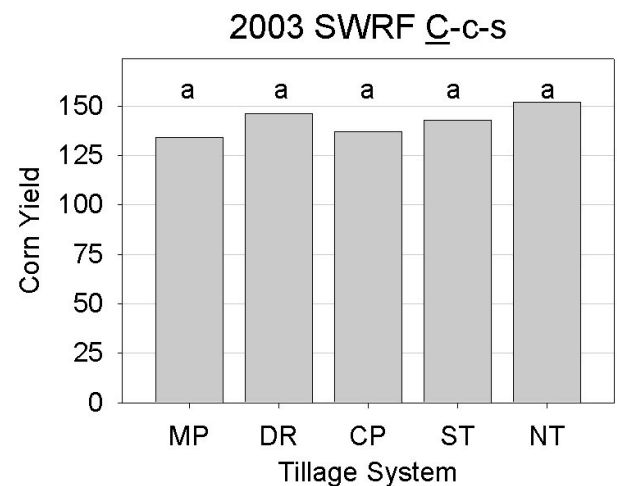


Figure 2. Effect of tillage system on corn yield in a corn-corn-soybean rotation for 2003 at Lewis, IA.

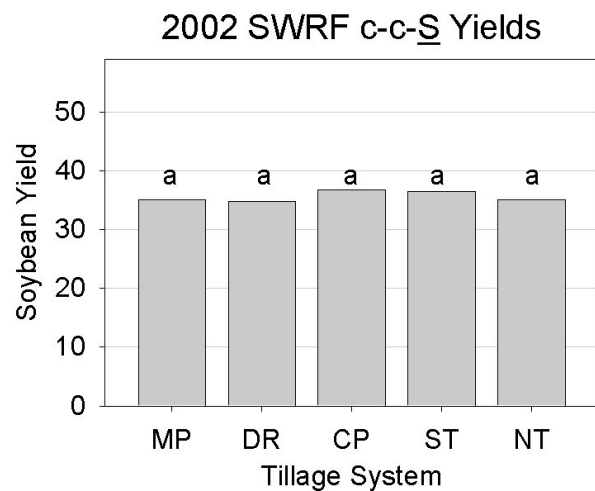


Figure 3. Effect of tillage system on soybean yield in a corn-corn-soybean rotation for 2002 at Lewis, IA.

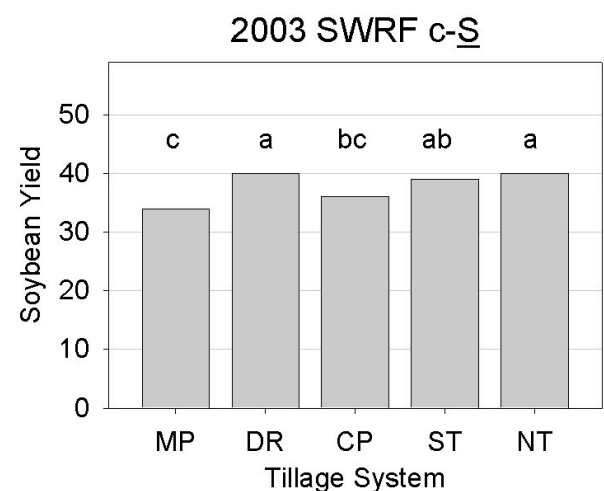


Figure 4. Effect of tillage system on soybean yield in a corn-soybean rotation for 2003 at Lewis, IA.